

PROJECT facts

U.S. DEPARTMENT OF ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Strategic Center
for Natural Gas

09/2000

LOW-COST MANUFACTURING OF MULTI-LAYER CERAMIC FUEL CELLS

PRIMARY PROJECT PARTNER

NexTech Materials, Ltd.
Worthington, Ohio

TOTAL ESTIMATED COST

\$1,862,118

COST SHARING

| | |
|---------|-------------|
| DOE | \$1,438,665 |
| Non-DOE | \$ 423,453 |

CUSTOMER SERVICE

(800) 553-7681

STRATEGIC CENTER FOR NATURAL GAS WEBSITE

www.netl.doe.gov/scng

Project Description

NexTech Materials, Ltd., an advanced ceramics manufacturer located in central Ohio, has assembled an alliance of materials and manufacturing organizations to address issues related to cost reduction and performance of solid oxide fuel cells. The team consists of five Ohio organizations: NexTech, Edison Materials Technology Center (EMTEC), Wright-Patterson AFRL/ML, Cobb & Company, and Ohio State University. Other members of the team include organizations from the adjoining Midwest region, each with their own innovative contribution to the program. These include Oak Ridge National Laboratory, University of Missouri – Rolla, Northwestern University, and Iowa State University. Three industrial firms will participate as commercialization partners to NexTech: Institute of Gas Technology, Advanced Materials Technologies, and Adaptive Materials.

The major activities of the program include:

- Design for manufacturing and cost evaluation of four potential, high-volume manufacturing approaches for 5-kW power modules;
- Small-scale development of ceramic multi-layer manufacturing processes and production of component prototypes;
- Limited single-cell testing, and demonstration of novel non-destructive and destructive evaluation techniques.

Upon completion of the two-year program, the technology developed optionally will be demonstrated in an automated manufacturing environment.

Goals

The outcomes of the program will be measured based on DOE's criteria for the next generation of fuel cells. Of these, the key evaluation criteria for this project will be projected manufacturing costs, scalability, and competitive reliability/maintainability.

The figures below depicts three parallel paths designed to minimize technical risks while maximizing the opportunity to assist achievement of NETL criteria for the high-temperature solid state fuel cell program. A colloiddally deposited electrolyte on the tape cast cathodes/anodes approach will be studied to determine the best manufacturing approaches to co-sinter planar electrolyte elements (Figure 1). The alternate electrode will be deposited by screen-printing (not pictured).

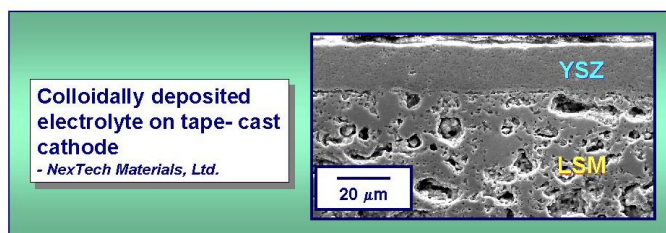


Figure 1



CONTACT POINTS

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PROJECT PARTICIPANTS

OHIO

Edison Materials Technology Center (EMTEC)

Dayton, Ohio

Wright-Patterson AFRL/ML

Akron, Ohio

Cobb & Company

Akron, Ohio

Ohio State University

Columbus, Ohio

MIDWEST

Oak Ridge National Laboratory

Oak Ridge, Tennessee

University of Missouri – Rolla

Rolla, Missouri

Northwestern University

Evanston, Illinois

Iowa State University

Ames, Iowa

COMMERCIALIZATION PARTNERS

Institute of Gas Technology

Chicago, Illinois

Advanced Materials Technologies (AMT)

Denver, Colorado

Adaptive Materials, Inc. (AMI)

Ann Arbor, Michigan

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Assuming manufacturing cost analysis warrants it, a second parallel thrust would explore means to scale up and prove the co-extrusion of monolithic SOFC components as illustrated in Figure 2. The patented process (Adaptive Materials, Inc.) offers the ability to fabricate multi-layer components with 10-micron-thick electrolyte membranes, an unprecedented design feature. Proving fabrication and ability to co-sinter will be major research tasks.



Figure 2

Figure 3 shows a third major parallel thrust that will explore a patented (University of Missouri-Rolla) spin-coating approach to lay down ultra-thin-film electrolytes. An important attribute of this process is that it has the potential to lower operating temperatures substantially.

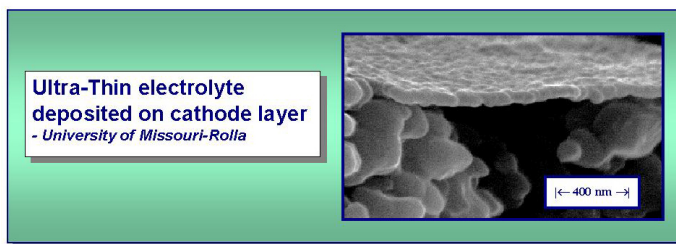


Figure 3

Success of this project hinges on NexTech's reputation for understanding of SOFC materials and a business focus to be a manufacturer of materials and fuel cell components. NexTech's considerable experience with management of and participation on multidisciplinary teams has qualified them to manage the diverse team assembled. Current experience includes NexTech's catalyst development program supported by DOE and its program on electrolyte fabrication technology supported by EMTEC, both of which involve many partners.

Project Benefits

The commercialization of solid oxide fuel cell technology has been hampered by high manufacturing costs and production hurdles. This program is taking a novel team approach to evaluate fresh ideas that lend themselves to manufacturing based on proven, high-volume, low-cost techniques. Solid oxide fuel cell technology is expected to become competitive to serve multiple markets in stationary power applications, distributed power generation, and auxiliary power unit applications. NexTech's major advantage is that they are not married to a single manufacturing approach or concept but are well positioned to support the best ideas and the people behind them.